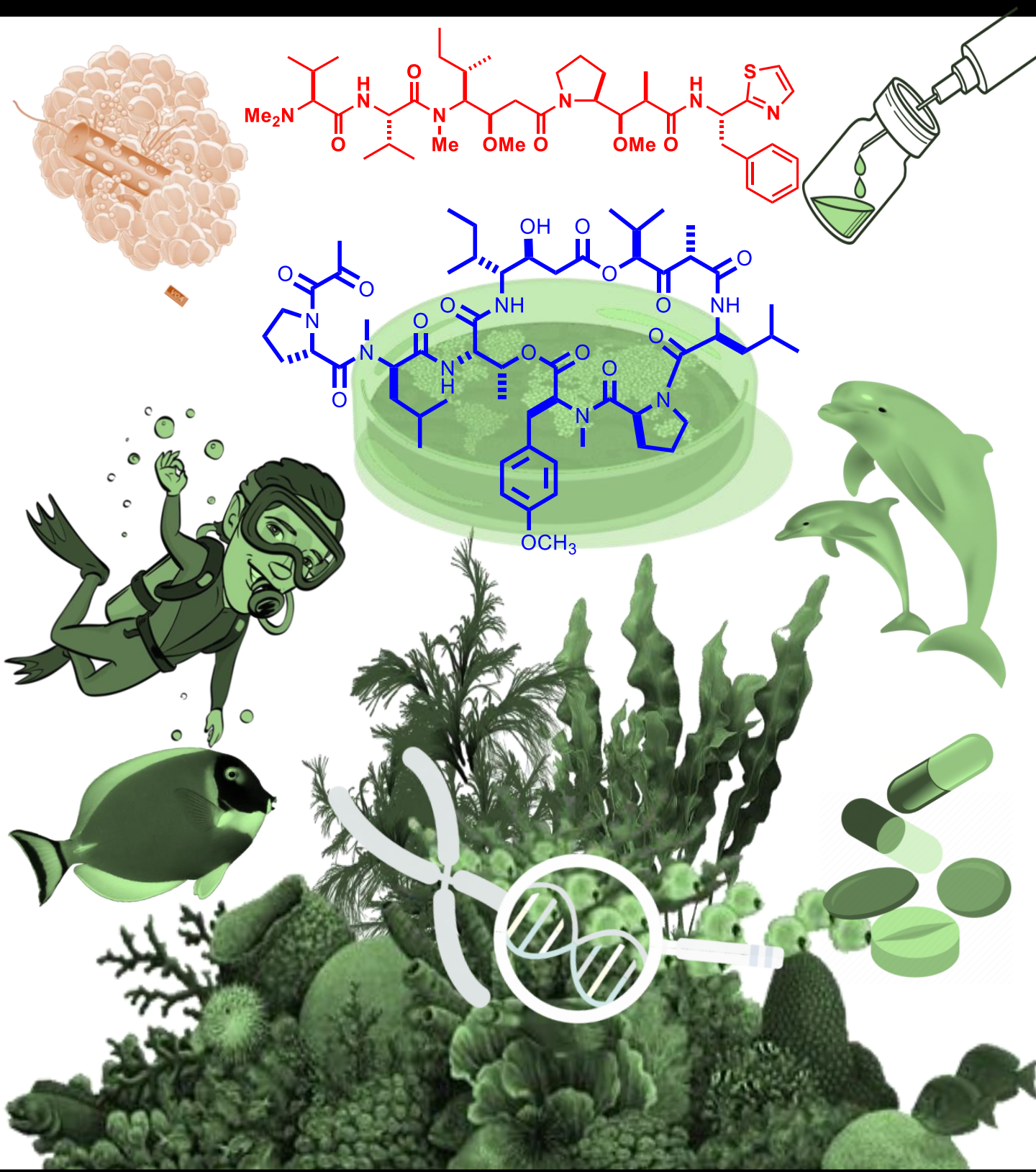
Marine Drugs

2021 – 2022 {Lecture 1}



Dr. Omar M. Sabry

Marine Drugs

I. Introduction

❑ Need for Marine Natural Products Science

By the end of the 20th century, disease resistance to antimicrobial, anti-viral, anti- inflammatory and to anticancer drugs continued to grow at an alarming rate. Appearance of new diseases also has been noticed. As oceans represent more than 70% of the earth's surface and because marine environment characterized by new, exciting, and useful chemistry, Seas and Oceans can be considered as a wealth source of bioactive natural products. Natural Products Chemists were increasingly turning to Marine Natural Products {MNPs} as a new source in the search for biologically and pharmacologically active new drugs.

❑ Marine Natural Products Science is a Modern Science

Before early 1970th, there was no SCUBA Diving {SCUBA = Self-Contained Underwater Breathing Apparatus}, also no submarines {Submersibles}. In 1970th SCUBA Coupled with submarine vehicles, allowed relatively easy accessibility of both shallow and deep-water marine organisms for studies by natural products chemists. Marine natural products science is a modern science started in the late 1970th.

❑ Divers can't go deeper than 100 feet in ocean's water

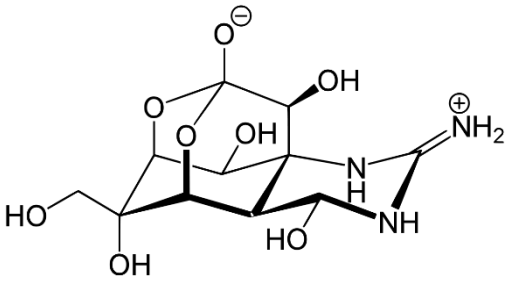
As if they are going deeper than that, they will suffer from Azotemia {Azote = Nitrogen and emia = blood}. It is a medical condition characterized by abnormally high levels of nitrogenous substances in the blood. Divers will suffer from narcotism, embolism and death.

❑ Marine Natural Products Science

It is important for marine drug scientists to study Marine Natural Products four branches. As after understanding the main ideas of each branch, they can inspire and discover new drugs from each branch.

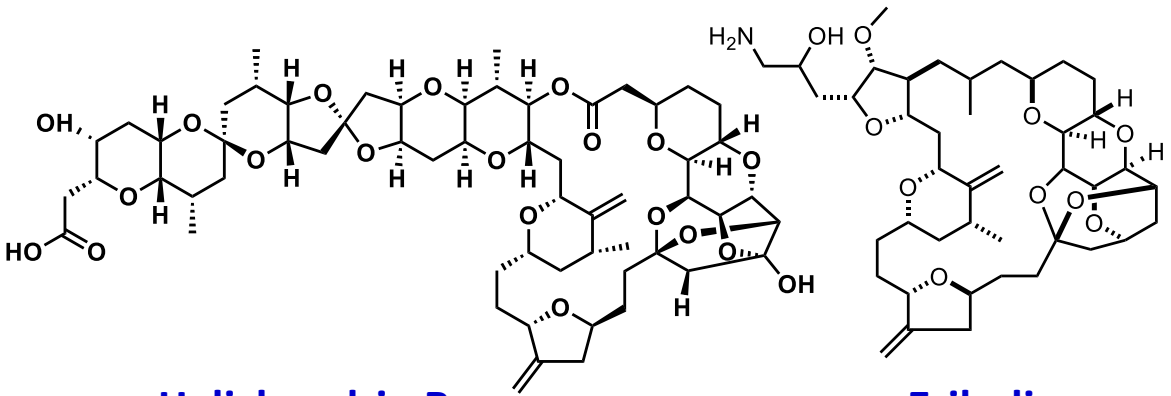
Marine Natural Products Science four main branches are:

A- Marine toxins: Toxic compounds isolated due to food poisoning. Mostly are non-proteinaceous {Heat Stable} e.g. Tetrodotoxin, a strong sodium channel blocker converted to a pain killer drug {Halneuron^{TR}} by WEX Pharmaceuticals Canada. Halneuron is 3000 more potent than morphine.



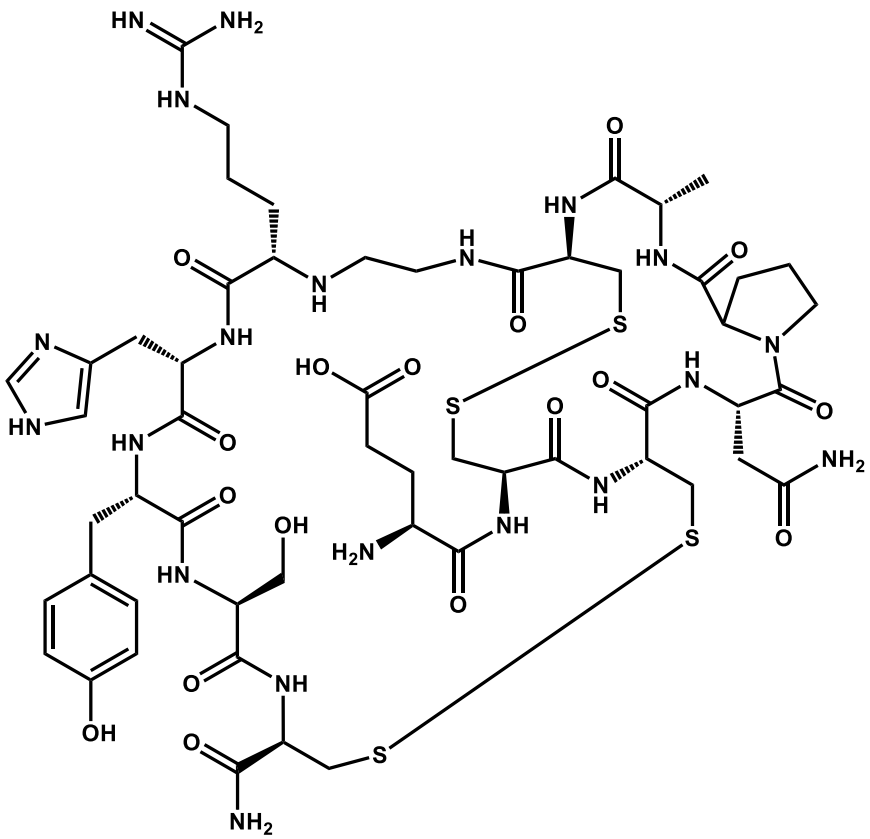
Tetrodotoxin

B- Marine pharmaceuticals: Bioactive compounds isolated as a result of drug discovery research e.g. Halichondrin B as anti-mitotic in breast cancer isolated from *Halichondria* sponge. Structure of Halichondrin B was modified {Structurally trimmed to give Eribulin - Halaven^{TR}} to decrease side effects and toxicity.



Halichondrin B **Eribulin**

C- Marine Chemical Ecology: Chemical interaction of marine creatures with each other e.g. Cone snail injects mixture of polypeptide toxins {more than 100 polypeptides e.g. ω-conotoxin {most strong} paralyzing fish {Blocking Ca^{++} channels of the neurons in the spinal cord - showing strong pain killing activity in persons suffering from chronic pain in cancers}.



ω-conotoxin

D- Marine Biotechnology: Deals with isolation of the gene clusters responsible for biosynthesis of certain bioactive compounds and transferring them to yeast, *E. coli* or to plant cells {transgenic plant cells} to produce large quantities of the active constituents *in-vitro* e.g. Transfer of gene cluster from diatoms producing omega-3 fatty acids with 7 un-saturations to *E- coli*.

❑ Marine Creatures Taxonomy

Marine Natural Products scientists must have at least a simple background about classification {Taxonomy} of marine creatures like **marine microorganisms (Bacteria and Fungi) - marine algae {Blue green algae = Cyanobacteria}, marine sponges, marine corals {Soft and Hard Corals}, marine bryozoans, marine mollusks, marine nudibranchs, marine tunicates, marine echinoderms, marine coelenterates and marine mammals**.

During marine samples collection, divers team members must know that each class of marine organisms contains certain chemical groups of active constituents with specific pharmacological activities e.g. Blue green algae {Cyanobacteria} contain polypeptides and cyclic depsipeptides showing promising cytotoxic activity against cancer cells. Researchers will avoid samples known to contain inactive compounds